

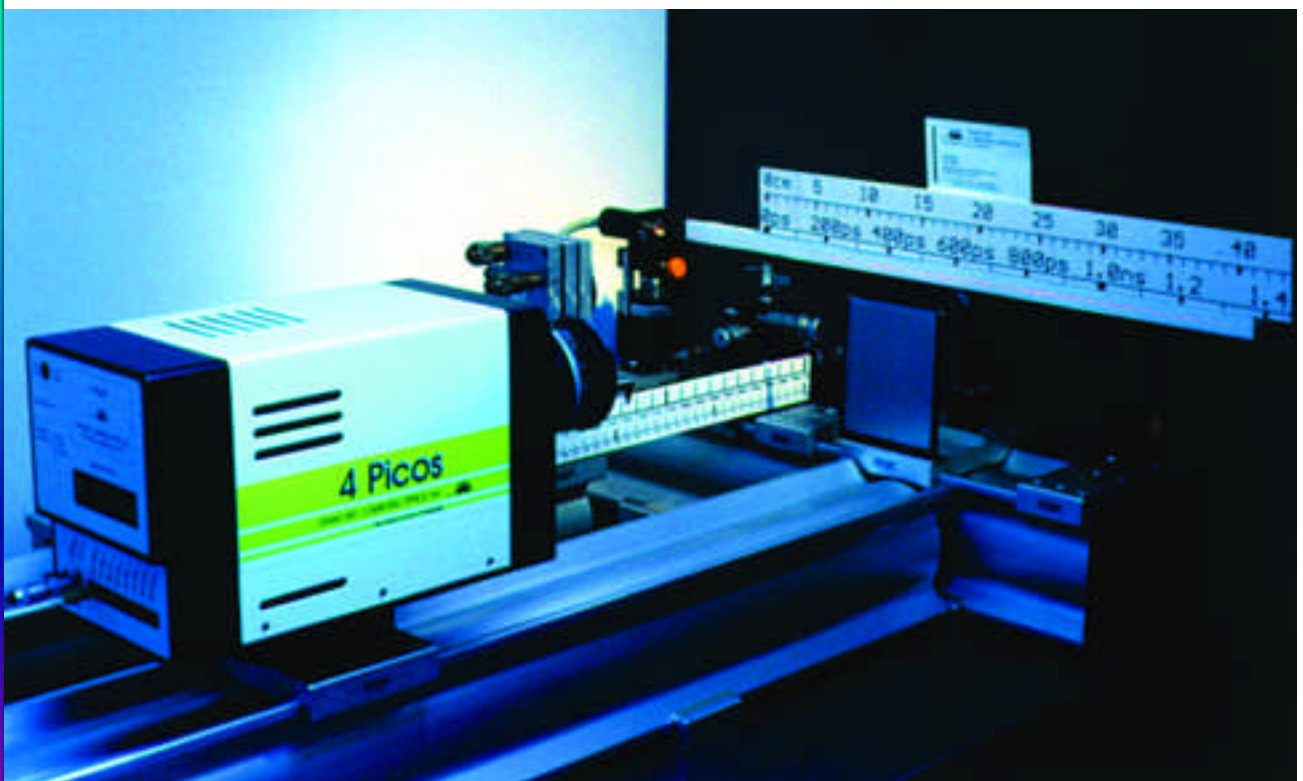


4 Picos/...

The most compact intelligent ICCD **picos-fast** camera system (analog or digital output)

Standard Features

- Nano-fast shutter down to 0.2ns
- Gating times from 0.2ns- DC (longer times optional)
- 18 or 25 mm Image intensifier
- Spectral Sensitivity of photocathode from UV - NIR (110 - 1300nm)
- Multiple Exposures
- Single Photon detection
- Analog (EIA/CCIR, VGA) or digital output (10 or 14 Bit with Standard or High Resolution)
- Customized f/0.8 distortion free lens coupling between image intensifier and CCD
- High Dynamic Range: 14 Bit (21 Bit with 4 Spec E spectroscopy software)
- Effortless Image/Data storage and retrieval
- Single Trigger Discriminator integrated
- Internal or external trigger
- Free Terminal software and printed manual



Specifications

Unique Features	4 Picos	4 Quik E
Shortest gating time	200ps	1.5 ns
Intensifier output coupling	customized distortion free f/0.8 relay lens	
Optical input	c-mount (standard), Nikon F-mount (optional)	
Optical input window	fused silica	
Sensitivity corresponding to conventional film	$1 \times 10^{12} \text{fc} = 50 \times 5^7 \text{ASA}$	
Multiple exposures, „dead“ time between exposures	any sequence $0.3 \mu\text{m}$	
Gate repetition rate	3.3MHz burst, 200kHz continuous	
TTL pulse (incorporated)	standard	
Remote control	RS 232 (digital set up)	
CE certified	yes	

Adaptation to in situ light level variations by internal digital programmable brightness control of the electronic shutter action, with exact reproducible digital setting of delay and exposure times.

Very high system integration permits small physical size of the total unit (all in one) — even very difficult surveillance jobs are mastered easily by remote control.

Programmable control parameter entry via RS 232 (digital set up), remote control software included.

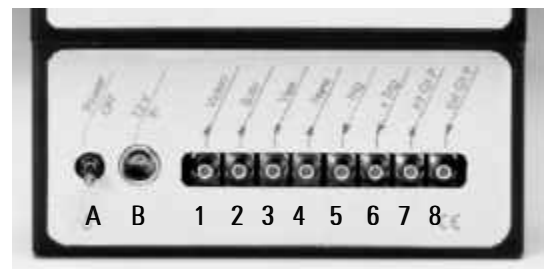
Distortion free imaging due to advanced proximity focused MCP (Micro Channel Plate) image intensifier and use of highest quality CCD array for best sensitivity and resolution.

14 Bit High Dynamic Range (theoretical limit 16 bit),
with 4 Spec E Spectroscopy PC Software up to 21 Bit/ Spectrum with all lines integrated.

Automatic Exposure Control and Automatic Gain, for unattended operation under greatly varying light conditions (optional). Effortless Image/Data storage and retrieve via system interface RS 170 to an external VCR (standard), frame grabber or optical disk (optional).

Switches and Connections

No.	Item	Function
A	Switch	Power Switch ON/OFF
B	Socket	Power Supply Socket (12V)
1	Video	Camera output signal (RS170 or CCIR)
2	Busy	Synchronization Signal (TTL), e.g. Frame Grabber
3	V_{init}	Asynchronous reset of CCD camera
4	F_{Sync}	TTL output for synchronization purposes
5	-Trig	Trigger input, negative edge TTL
6	+Trig	Trigger input, positive edge TTL
7	IntGtP	Output of internal time delay gate pulse generator
8	ExtGtP	Input for control of HV MCP pulse (TTL)



Rear view of 4 Picos with legend

For control by internal time/delay generator, 7 and 8 are shorted internally. Camera will free run when 4 to 5, and 7 to 8 are internally connected. These settings are both under RS 232 control. Camera may be externally driven through 8 by external pulse delay generator when 7 and 8 are disconnected. Pulse monitoring is provided by 7 and camera master sync output is available at 4.

Image Intensifier

Image Intensifier specifications	
Image intensifier type (proximity focused MCP)	single stage (standard), dual stage (optional)
Phosphor material	P43, P46
Image intensifier diameter (mm)	18mm, 25mm
Image area of the relay lens	25mm MCP: 20 x 15mm, 18mm MCP: 14.4 x 10.8mm
Wavelength range, subject to window design	180 – 1300nm quartz window (standard) 110 – 850nm MgF2-window (S20UV optional)
Spectral Sensitivity of MCP (nm)	110..1300nm, depends on the type of the photocathode
Quantum Efficiency (Q.E.) (see curves below)	depends on the type of the MCP, up to 35%
Gain (4k steps) ($V_{MCP} = \dots 1000V$) control via RS 232 digital setup	single stage MCP: 4×10^4 dual stage MCP: 4×10^6
Signal to noise (db @ μLx)	46dB min @ $0.5\mu Lx$
Coupling phosphor (MCP → CCD)	customized 6 element f/0.8 relay lens No distortion! No vignetting! No pin cushion!

Spectral Sensitivity of Photocathodes (Wavelength in nm)					
Standard 25 mm			Optional 25 mm		
S20	C	approx. 165 - 820nm	S20 UV(MgF2)	A	approx. 110 - 820nm
S25	F	approx. 200 - 840nm	Solar Blind (CsTe)	G	approx. 180 - 340nm
Standard 18 mm			Bialkali		approx. 165 - 600nm
S20UV	B	approx. 165 - 820nm	Enhanced S20	D	approx. 165 - 820nm
S25 IR (Super S25)	H	approx. 350 - 920nm	Enhanced S25 (glass)	I	approx. 270 - 900nm
Optional 18 mm			Wideband S25 WB	K	approx. 200 - 900nm
Broadband	J	approx. 190 - 920nm	S1	E	approx. 700 - 1300nm

Deviations of up to $\pm 25\%$ from the above typical spectral sensitivity curves are possible. The position of the curves can vary $\pm 20nm$.

The input window material limits the spectral response of the photocathode in the shorter wavelengths.

The window materials and their transmission limits are:
quartz (165nm), MgF2 (110nm).

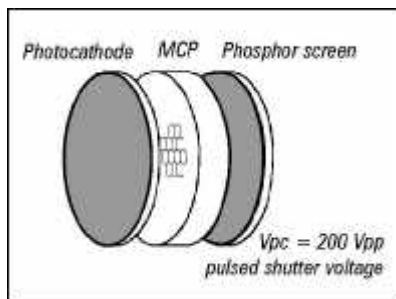
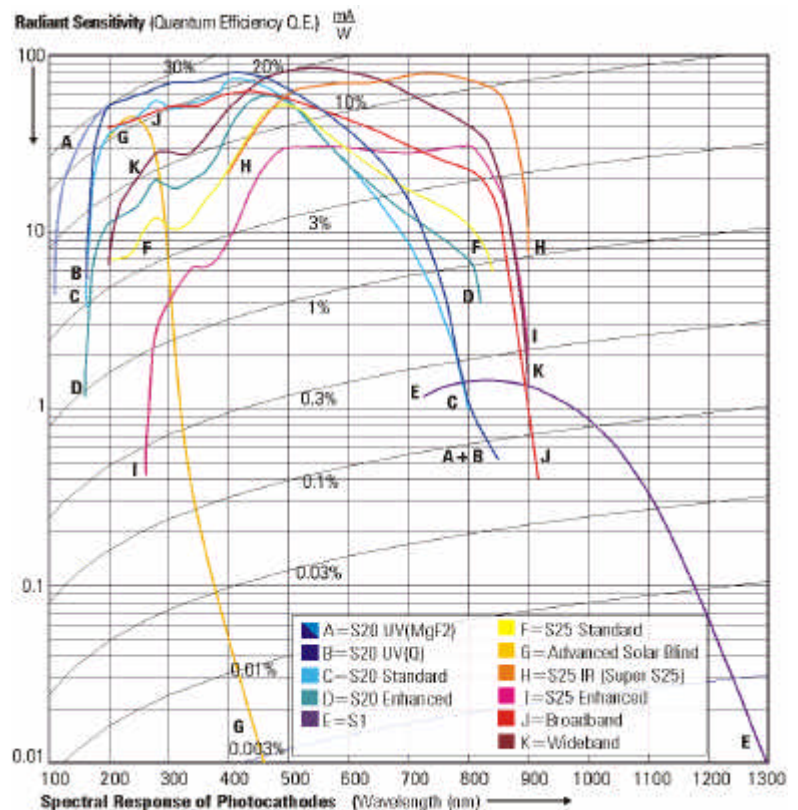
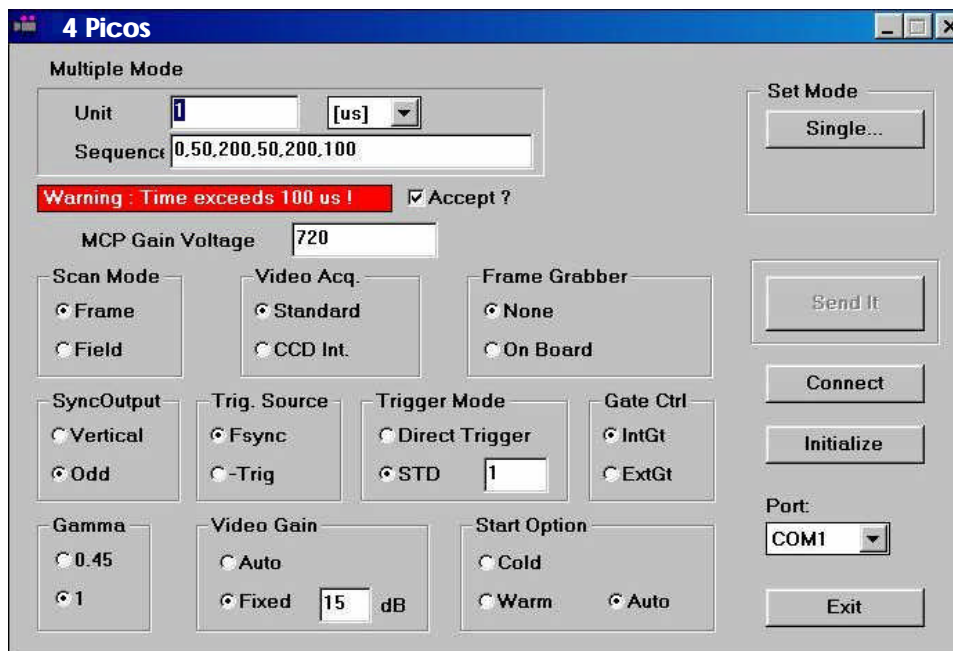


Image intensifier and shutter (schematic)



CCD-Video Unit

CCD Video Chip	Analog Output		Progressive Scan CCD	Standard Resolution CCD	High Resolution CCD
	USA, Japan	Elsewhere			
Analog or digital output	analog EIA (RS 170)	analog CCIR	analog, VGA 30/60Hz or 60/120Hz	digital 10 or 14 Bit	digital 10 or 14 bit
Resolution (pixel)	768 x 494	752 x 582	640 x 480	782 x 582	1368 x 1020
CCD Pixel size (μm)	8.4 x 9.8	8.6 x 8.3	9.8 x 9.8	8.6 x 8.6	4.8 x 4.8
Imaging frequency (analog) Frame rate (digital)	30/60Hz	25/50Hz	30/60 (30/60Hz) 60/120/200/240/350 (60/120Hz)	10bit: 32/62/108fps 14bit: 16/31/54fps	10bit: 10/20/35fps 14bit: 5/10/18fps
Dynamic Range A/D (Bit)	14 Bit, up to 21 Bit (with 4 Spec E spectroscopy software)				
Video Gain	0...25dB, automatic or manually adjustable through computer RS 232 interface			10bit: 0..10dB, ... RS 232 14bit: 0..25dB, ... RS 232	
Binning vertical (pixel)	Software			1,2 pixel, ROI	
Binning horizontal (pixel)	Software			1,2 pixel, ROI	
Image Sensor	ICX..AL				
Chip Readout	Correlated double sampling, dark current corrected				
Output	1V _{pp} (75 Ω), composite video, EIA, CCIR or VGA				
Scan Mode	Field/Frame, selectable through computer RS 232 interface. ICCD camera 4 Picos or 4 Quik E may be Genlocked or supply Fsync-pulse to operate as master clock.				
Gamma	1 or .45, selectable through computer RS 232 interface				
Internal Synchronization	Free run mode				
External Synchronization	by negative edge TTL pulse (Vinit)				
Signal to noise	46dB min @ 0.5 μLx				
Cooling of CCD (optional)	Regulated cooling of CCD camera unit to 14°C to minimize dark current by a factor of 10 for exposure times above 100 ms. Provides single photon sensitivity. No condensation; eliminates need for vacuum or special nitrogen atmosphere.				



4 Picos control window

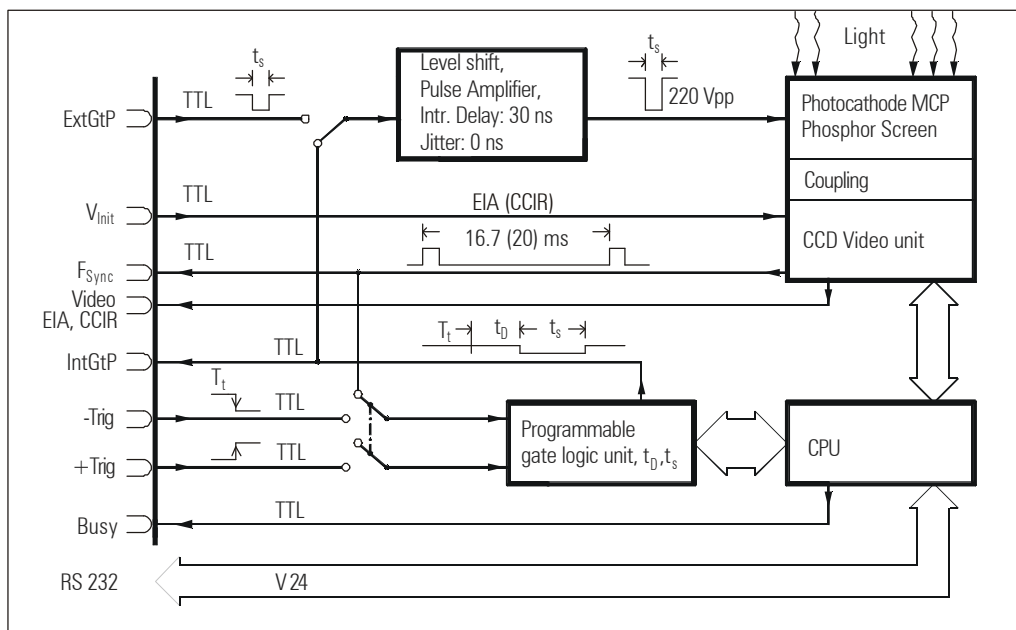
Shutter control

The advanced, digitally controlled shutter delay feature is the perfect match for your laser, range gating, flow analysis, or many other high speed applications. It is operational in 'scattered light' environments, underwater or for highest speed multi-instrument sequential image acquisition. Multiple direct images with a repetition/ delay time setting as short as $0.3\mu\text{s}$ can be synchronized with ease to any external TTL source.

Internal exposure control	4 Picos	4 Quik E
Time (t_s) and delay (t_D) of the gate pulse, or multiple exposure with CPU internally digital programmable	$t_s = 200\text{ps} \dots 80\text{s}$, min. steps 10ps $t_D = 0 \dots 80\text{s}$, min. increments 10ps	$t_s = 1.5\text{ns} \dots 80\text{s}$, min. steps 100ps $t_D = 0 \dots 80\text{s}$, min. increments 100ps
Trigger propagation delay	<65ns, less than 20ps jitter	
Initializing	-Trig, +Trig, or FSync	
Multiple Exposure	Any sequence, $0.3\mu\text{s}$ "dead time" between exposures	

External exposure control	4 Picos	4 Quik E
Control of the camera internal Pulse E amplifier via ExtGtP (TTL Pulse) input: Shutter continuous from:	$t_s = 200\text{ps} \dots \infty$, t_D, ∞ t, t_D determined by external device	$t_s = 1.5\text{ns} \dots \infty$, t_D, ∞ t, t_D determined by external device
Trigger propagation delay	<45ns, no jitter	

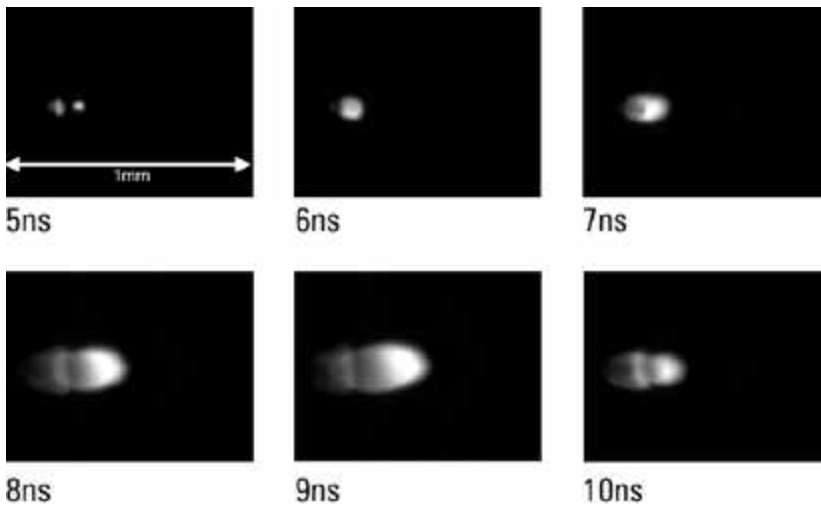
Automatic exposure control (optional)	4 Picos	4 Quik E
Pixel by pixel exposure analysis providing automatic light level control by instantaneous adjustment of camera shutter speed and intensifier gain for very wide range of lighting conditions (up to 12 orders of magnitude).	200ps ... 15 (18) ms, Shutter time and MCP gain automatically adjusted, in response to scene illumination.	1.5ns ... 15 (18) ms



Analog shutter control (schematic)

Mechanical & Environmental Data

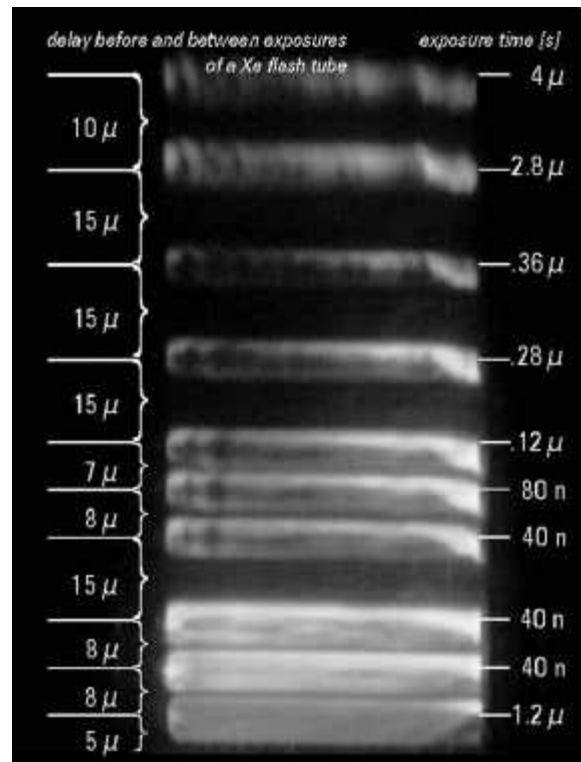
Mechanical & Environmental Data, Power Requirements	
Camera dimensions, without lens (mm, inch)	248 x 110 x 135mm (l x w x h) 9 ³ / ₄ x 4 ³ / ₈ x 5 ⁴ / ₁₆ " (l x w x h)
Camera weight (all in one) (kg / lb)	3kg / 6.6lb
Camera mount (at the bottom plate of the camera)	1/4" x 20 and M8 mounting hole
Operating Humidity (%)	25..95%, non condensing
Operating temperature (°C / °F)	0°C – 50°C / 32°F – 122°F
Performance specification	10°C – 40°C / 50°F – 104°F
Operating limits	-10°C – 50°C / 14°F – 122°F
Shock and Vibration	60 g accel. shock, 7g Vibration (11 – 200Hz)
Voltage	12 V +5%/-2%



Analysis of plasma development with 4 Picos camera: single beam set up.
 Plasma images of water droplets
 Shutter time: 200ps
 Laser Pulse: 50mJ, 8ns
 © 2003 with courtesy of Ch. Janzen, Fraunhofer Institut Aachen, Germany.



Multiple exposures (Mouse trap)



Multiple 16 bit exposures of Xe flash tube, single discharge, 10 exps during 120μs, continuously swept by scanning mirror.

4 Picos/... intelligent ICCD Camera Family

analog or digital output

	4 Picos/0.2-25*	4 Picos/0.2-25**/dig		4 Picos/0.2-18**	4 Picos/0.2-18**/dig					
*25mm Standard: S20 or S25 **18mm Standard: S20 or Super S25 Optional: Bialkali/Fused Silica, Advanced Solar Blind (RbTe, CsTe) Enhanced S25, Enhanced Blue-UV S20, Wideband S25 WB Two photocathode window materials may be ordered depending upon the required response.										
Standard										
Gating Speeds from 200ps → ∞	■	■		■	■					
Image Intensifier with 25mm MCP	■	■								
Image Intensifier with 18mm MCP				■	■					
Integrated, gateable system	■	■		■	■					
Image Intensifier with Single stage MCP	■	■		■	■					
Image Intensifier with V-stack dual stage MCP	□	□		□	□					
Lens Coupling	■	■		■	■					
High Efficiency customized f/0.8 relay lens	■	■		■	■					
Multiple Exposures	■	■		■	■					
Shutter dead time 0.3μs	■	■		■	■					
Integrated Single Trigger Discriminator (STD)	■	■		■	■					
Analog CCD video output EIA, 768 x 494 pixel or CCIR, 752 x 582 pixel	■			■						
Progressive Scan CCD, VGA, 640 x 480 pixel	□			□						
Standard Resolution CCD, 10bit, 752 x 582 pixel		■			■					
Standard Resolution CCD, 14bit, 752 x 582 pixel		□			□					
High resolution CCD, 10bit, 1368 x 1020 pixel		□			□					
High resolution CCD, 14bit, 1368 x 1020 pixel		□			□					
Terminal Software and printed manual	■	■		■	■					
Comfortable case for shipment & storage for free	■	■		■	■					
Additional Options										
Peltier Cooling	□	□		□	□					
Special Spectrograph Adapters	□	□		□	□					
Automatic Exposure Control	□	□		□	□					
Internal Frame Grabber (analog or digital)	□	□		□	□					
Image Intensifier with Special Photocathodes	□	□		□	□					
Nikon F-mount Adapter	□	□		□	□					

■ standard □ optional

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Applications

Physical Sciences

Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
Laser induced fluorescence

Engineering Research

Particle Tracking Velocimetry (PTV)
Particle Imaging Velocimetry (PIV)
Automotive Fuel Injection
Spray analysis
Wind tunnel studies
Stress analysis of ceramics materials

Biological Sciences

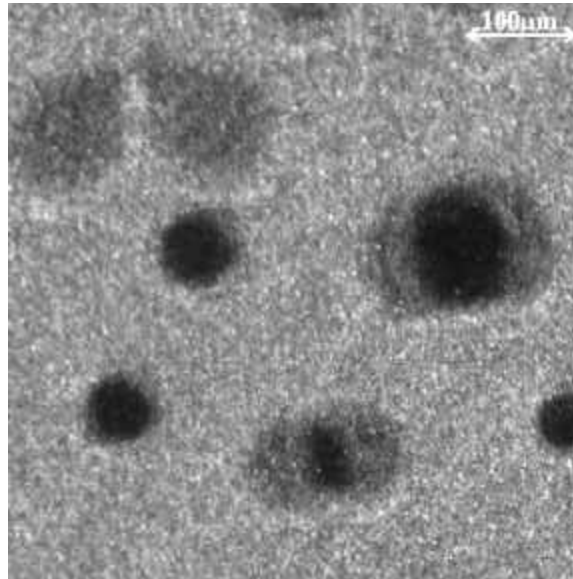
Cancer research
Fundus imaging spectroscopy
X-ray detection
Luminescence
Time resolved fluorescence

High Speed Imaging

Dynamic Schlieren Phenomena
Shock tubes
Range gating

Low Light Imaging

Thomson Scattering
Raman Spectroscopy
Glow Discharge Spectroscopy
Semiconductor failure analysis



Double shadow view of 30-100µm particles in a 500m/s plasma spray, 5ns exp. time.

© with courtesy of T. Streibl, HSBW, Neubiberg, Germany



Nitrogen-laser-based system for oral cancer diagnosis developed at Center for Advanced Technology, Indore, India

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